1. Introduction

1.1. Problem formulation

The digitalization of businesses is continuing and is disrupting industries and their business models. The term **digital transformation** has reached all the business functions and business processes. We see fundamental changes in operations and organizations to support the digital transformation.[1] Enterprises are forced to go the path of digitalization and to accept, that reaching the required maturity as soon as possible will be critical for survival.

This research is specifically focusing on the tax function of an enterprise. The tax functions are also under pressure to transform their organizations to be fit for the upcoming tax challenges, to support the business during their digital transformation, to remain a good taxpayer by ensuring compliance to all regulations, and to establish smooth cooperation with tax administrations. The finance and the tax function environment has started to use the upcoming technologies and techniques like business intelligence (BI), artificial intelligence (AI) and machine lear-

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1   Mittal, S., Khan, M. A., Romero, D. & Wuest, T. 2018. A critical review of smart manufacturing & Industry 4.0 maturity models: Implications for small and medium-sized enterprises (SMEs). *Journal of manufacturing systems*, 49, pp. 194-214, p. 194.

ning (ML), blockchain, enterprise performance management (EPM), data lakes, and others. *Risse* summarized digitalization requirements and solutions for tax compliance by providing digitalization use cases for the different tax areas (VAT, transfer pricing, and customs).[2] These new technologies and techniques are progressing with a wide variety of implementations. Especially business models using digital sales platforms are under pressure to implement additional reporting requirements to the tax administrations on income derived by sellers, for example, Council Directive 2021/514 (DAC7) to enter into force as from 1 January 2023.

The daily work and the responsibilities of a tax function are under tremendous change pressure. The tax function includes different units like the corporate tax departments and the tax compliance units of the in-house Global Business Services (GBS) or Shared Service Center (SSC). Many MNE's have outsourced parts or substantial parts of their tax function's operational work to tax service (consultancy and compliance) providers. The in-house tax functions have to be seen as an integrated part of the CFO unit. The owner of the tax business processes is working in a tight relationship with external service providers and has to co-operate closely with the tax administrations.

The service offering for tax consultancy and tax compliance support by professional tax advisors is changing as well to meet the requirements of the in-house tax functions. On the other side, the tax administrations have identified a digitalization transformation need to cover the new digital business models and to ensure effective tax collection with the newest technology and software. The standards of the internal control systems and especially the Tax Control Framework (TCF) are also getting much stricter. Business functions, tax functions, tax service providers, and tax administrations are depending on each other.

Where is the digital transformation journey for tax functions going to? What is the vision of the tax function? To start a transformation journey, both the "as-is" and the envisioned "to-be" need to be identified and defined. As a next step, an effective transformation plan with clear measures to reach the to-be in a given timeline has to be worked out.

Maturity models (MM) are stage growth models and are supporting decision-makers to conclude on the as-is stage and then to identify the desired to-be stage of an organization. The milestones of the journey between the current stage and the desired stage are outlined by defined maturity levels at each stage.

The number of articles on maturity models has been growing significantly over the last decade. *Kalinowski*[3] has identified 60 articles in literature (from 2002 to 2017)

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2   Risse, R. 2021. Die digitalisierte Tax Compliance: Anforderungen und Lösungsansätze dargestellt anhand von Praxisbeispielen. In: Seer, R., Lüdicke, J. & Rasch, S. (eds.) *Globalisiertes Steuerrecht – Anspruch und Verantwortung*. Verlag Dr. Otto Schmidt, p. 65.

3   Kalinowski, T. B. 2018. Business process maturity models research – a systematic literature review. *Economic and Social Development: Book of Proceedings*, pp. 476-483.

discussing models in the area of business process maturity (BP-M) or business process management maturity (BPM-M). Especially the design of Industry 4.0 maturity models has been a research focus in recent years. The BP-M or BPM-M models covered in the study by *Kalinowski* do not include specific measurements of digitalization. In total fifteen digital maturity (DM) models have been unearthed in the literature review by *Schwer et al.*[4] that were built by 147 variables in total. Both, the BPMMs and DM models are the foundation for MM for tax functions. Standardized enterprise digital maturity models (DMM) also allow benchmarking with other companies if they are used more commonly or by a consultancy company globally or for specific industries.

The reshaping of the global taxation framework and the development of new digital business models raises also for the tax functions the need to formulate a vision and identify the required digital capabilities. A strategy-oriented digitalization approach is asked by the top-level management. Digitalization maturity models for tax functions would support decision-makers to judge on a proposed vision and the journey to get there.

1.2. The objective of the research

The numerous maturity models available do not provide enough specifics to be used by tax functions without a redesign and detailed revalidation. Especially the specific capabilities needed by tax functions within a digitalization maturity model are a challenge and not broadly discussed in the literature. The push from outside by the tax administrations and their specific needs are adding a significant risk for organizations that are not prepared for the future requirements. This work should encourage a broader discussion in the research and in the tax service industry to identify the envisioned core capabilities of the future within a tax function, that are aligned with the tax administration's vision of a digital tax administration.

As a result of the thoughts above, the author has formulated the following research questions:

- Research question 1 (RQ1): Are digital tax maturity models for the maturity assessment of a tax function described in the research literature?
- Research question 2 (RQ2): How applicable are the available digital tax maturity models (DTMM) for the maturity assessment of a tax function?
- Research question 3 (RQ3): Are the capabilities of the DTMM relevant and to be considered in a digital tax maturity model for tax functions?

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4   Schwer, K., Hitz, C., Wyss, R., Wirz, D. & Minonne, C. 2018. Digital maturity variables and their impact on the enterprise architecture layers. Problems and perspectives in management, pp. 141-154.

To answer the research questions, this research has been structured two-folded:

- **Literature:** description and review of selected BP and BPM maturity models, selected DMMs, TMMMs for tax functions, and of the OECD tax administration 3.0 maturity model.[5]
- **Empirical work:**
  - literature search, description and review on DTMMs for tax functions and
  - survey: an empirical assessment of one selected DTMM by tax experts.

In Chapter 4 Results, the review and analysis of the different maturity models, especially on the DTMM, should provide more insight by comparing and evaluating the maturity model components used and by matching them to the digitalization capabilities of tax functions.

Some of the selected maturity models for analysis in this work may not be methodologically or theoretically sound but are used in practice for assessing organizations or for benchmarking purposes. The research results should allow decision-makers in a tax function or on C-level to analyze the identified DTMMs and their detailed components. The findings will support them when applying a MM for the formulation of a vision of the tax function.

This work should also encourage researchers to look holistically on the maturity assessments of tax functions and of the tax service industry, as the role of "paid taxes" is fostered due to the increased focus of the society on paying taxes by MNEs and of public stakeholders on receiving a fair tax portion for their jurisdiction.

1.3. Course of investigation

The methodology of this work is described above. Chapter 2 will provide a theoretical background on maturity models as well as insight into different types of maturity models. The author has been focusing first on models for business processes and business process management and then on digitalization maturity models. The identified specific tax management maturity models may not be covered by solid literature, but are provided by tax consultancy providers. The dependency of tax functions on the transformation of tax administrations is a given fact. An attempt was made to even further broaden the view on tax-related activities by addressing the need for non-profit organizations to be digitally mature. The non-profit organization will have to analyze and comment on disclosed tax information and other socially relevant information of MNEs. Chapter 3 is describing the empirical part of the study in detail. Chapter 4 is covering the results of the literature research and the survey undertaken, the review and analysis of DTMMs, and is providing a comparison of the model components.

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5   OECD. 2020. Tax Administration 3.0: The Digital Transformation of Tax Administration. Available: http://www.oecd.org/tax/forum-on-tax-administration/publications-and-products/tax-administration-3-0-the-digital-transformation-of-tax-administration.htm.

The research is confirming that there is little literature on DTMM as of today and is so underpinning the need to bring this transparency and to encourage others to further explore this field of research. The author is a practitioner in tax and statutory compliance and the digital transformation of the corporate and especially the tax compliance is on the daily agenda. Different surveys and articles published by tax consulting companies[6] and the published digital maturity model for tax administrations by the OECD are confirming the relevance of this research topic.[7]

2. Literature

2.1. Maturity models introduction

In the last decades, there have been many attempts to define "maturity". *R. L. Nolan*[8] and some years later followed by *P. B. Crosby*[9] began to discuss in general about maturity but also organizational maturity, and was presenting a maturity model. Maturity models (MM) are applied to various application domains and organizational functions. *Looy et al.*[10] delineated the development of MMs for software development and system engineering. Afterward, the use of MMs has been expanding to different areas like human resources, product management, and others. Many MM have been developed, but just a few have been validated by studies and most of them are lacking a sound classification of model levels.

The definition of maturity is stated as *"a very advanced or developed form or state"*.[11] The term "maturity model" is not defined in the above dictionary but the dictionary suggests as an alternative the term "capability maturity model" with the definition *"a five-stage method for developing and improving computer programs or management processes in order to meet high standards"*.[12] Maturity models reflect different realities and therefore also have different definitions.

ISO/IEC defines organizational process maturity as the *"extent to which an organization unit consistently implements processes within a defined scope that contributes to the achievement of its business needs (current or projected)"*.[13]

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6   EY 2020. The intelligent tax function – 2020 Global Tax Technology and Transformation Survey highlights. EY; KPMG. 2021. Digital transformation of the tax department. Available: https://home.kpmg/de/en/home/insights/2021/06/digital-transformation-tax-department.html [Accessed 23. Aug. 2021]; Deloitte, S., Krivinskas, M. & Costa, P. 2021. The digital journey of the tax function. *International Tax Review.* Available: https://www.internationaltaxreview.com/article/2a6a800txc7nnn2v1hr0g/the-digital-journey-of-the-tax-function.

7   OECD. 2020. Tax Administration 3.0: The Digital Transformation of Tax Administration. Available: http://www.oecd.org/tax/forum-on-tax-administration/publications-and-products/tax-administration-3-0-the-digital-transformation-of-tax-administration.htm.

8   Nolan, R. L. 1973. Managing the Computer Resource: A Stage Hypothesis. *Commun. ACM,* 16, pp. 399–405.

9   Crosby, P. B. 1980. *Quality is free: The art of making quality certain* (New York: McGraw-Hill, 1979), pp. 25–57.

10   Van Looy, A., de Backer, M. & Poels, G. 2011, Defining business process maturity. A journey towards excellence. *Total Quality Management & Business Excellence,* 22:11, pp. 1119-1137.

11   Cambridge Advanced Learner's Dictionary, http://dictionary.cambridge.org.

12   Cambridge Advanced Learner's Dictionary, http://dictionary.cambridge.org.

13   ISO/IEC. 2015. Information technology – Process assessment – Concepts and terminology. Available: https://www.iso.org/obp/ui/#iso:std:iso-iec:33001:ed-1:v1:en [Accessed 10 July 2021].

Process maturity is defined in OMG-BPMM as *"Process maturity is the extent to which processes are explicitly defined, managed, measured, controlled and effective. Maturing processes implies growth in capability and indicates both the richness of an organisation's processes and the consistency with which they are applied throughout the organisation."*[14]

A maturity model is defined in ISO/IEC as a *"model derived from one or more specified process assessment model(s) that identifies the process sets associated with the levels in a specified scale of organizational process maturity"*.[15]

Capability is defined as *"the ability to do something"*.[16] CMMI is defining process capability as *"The range of expected results that can be achieved by following a process."*[17]

Maturity models consist of different components and the combination of the components forms a complete model. *Rosemann* and *De Bruin*[18] have specified six components labeled as dimensions: a) Factor, b) Maturity Stage, c) Scope Organizational Entity, d) Scope Timing, e) Coverage, and f) Proficiency. They constructed a multi-dimensional BPM maturity model by using the dimensions listed below (Figure 1).
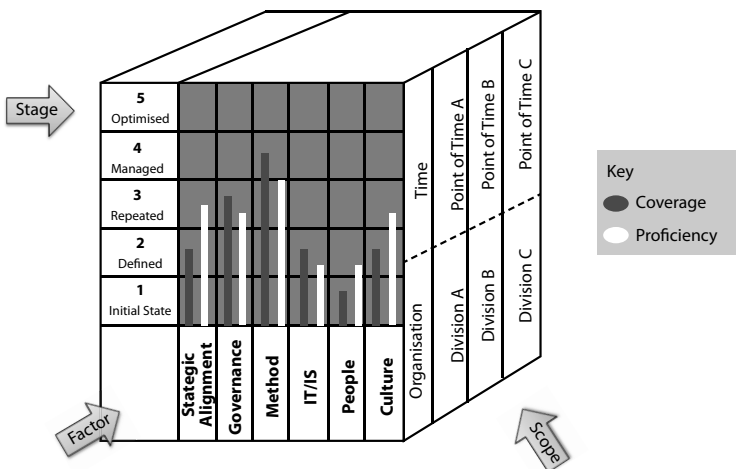

Figure 1: The BPM maturity model [ROSEMANN, M. & DE BRUIN, T. 2005, Towards a business process management maturity model. Thirteenth European Conference on Information Systems, 2005. London School of Economics, pp. 1-12, p. 8]

14   OMG, Business Process Maturity Model (BPMM) version 1.0. 2008, p. 72 Available: https://www.omg.org/spec/BPMM/1.0/PDF [Accessed 3.8.2021].
15   ISO/IEC. Information technology – Process assessment – Concepts and terminology. Available: https://www.iso.org/obp/ui/#iso:std:iso-iec:33001:ed-1:v1:en [Accessed 10 July 2021].
16   Cambridge Advanced Learner's Dictionary, http://dictionary.cambridge.org.
17   SEI 2000. CMMI for Systems Engineering/Software Engineering, Version 1.02, Continuous Representation (CMMI-SE/SW, V1.02, Continuous). Pittsburgh, PA: Software Engineering Institute Carnegie Mellon University.
18   Rosemann, M. & de Bruin, T. 2005, Towards a business process management maturity model. Thirteenth European Conference on Information Systems, 2005. London School of Economics, pp. 1-12.

The process maturity assessment is key for identifying the stage of maturity of a process. The Capability Maturity Model Integration (CMMI) is the most commonly used framework[19]. The CMMI resulted from further development of the CMM model.[20]

The CMMI framework distinguishes between five maturity levels: Level 1 – Initial, Level 2 – Managed, Level 3 – Defined, Level – 4 Quantitatively Managed, and Level 5 – Optimizing. The terminology and content of the different levels in MMs are not harmonized and could even have more or fewer levels. Also, the BPMM model of Figure 1 has a different terminology compared to the CMMI framework. A CMMI framework implementation does not guarantee a high business performance as it is focusing on the WHAT (what processes) rather than on the HOW (how to be implemented).

Literature reviews have been conducted for MMs. *Santos-Neto* and *Costa*[21] have performed a systematic literature review that revealed 409 relevant papers. It needs to be highlighted those studies not written in English were excluded from the research. In the years 2013 to 2017 around 40 to 50 papers were published every year. They have categorized the papers by the research focus. The development of MMs is the main research focus item with 49 %, followed by the application of MMs with 25 % and meta-analysis/others with 23 %, and the validation of MMs with only 3 %. Figure 2 shows the different areas of the performance of MMs. The study has differentiated fourteen different areas. SW Engineering/IT or IS management is the main area dealing with MMs in the literature, followed by business process management and project management. The number of maturity models continued to increase but there are still widespread shortcomings.
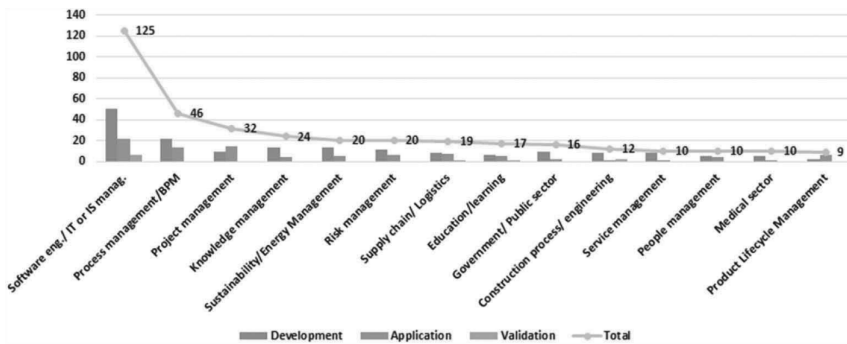

Figure 2: Area of the performance of MMs [Santos-Neto, J. B. S. D. & Costa, A. P. C. S. 2019. Enterprise maturity models: a systematic literature review. *Enterprise Information Systems*, 13, pp. 719-769, p. 735]

19   SEI 2000. CMMI for Systems Engineering/Software Engineering, Version 1.02, Continuous Representation (CMMI-SE/SW, V1.02, Continuous). Pittsburgh, PA: Software Engineering Institute Carnegie Mellon University.
20   Curtis, B. & Weber, C. V. 1995. *The capability maturity model: Guidelines for improving the software process*, Addison-Wesley Professional, pp. 29-40.
21   Santos-Neto, J. B. S. D. & Costa, A. P. C. S. 2019. Enterprise maturity models: a systematic literature review. *Enterprise Information Systems*, 13, pp. 719-769.

Most of the maturity models are missing scientific documentation on the design process and cannot be effectively compared. *Becker et al.*[22] have developed a procedural model for the design of maturity models for IT management. The design model consists of eight phases (see Figure 3). Whereas the last phase "Rejection of maturity model" is optional, if the results are unsatisfactory.
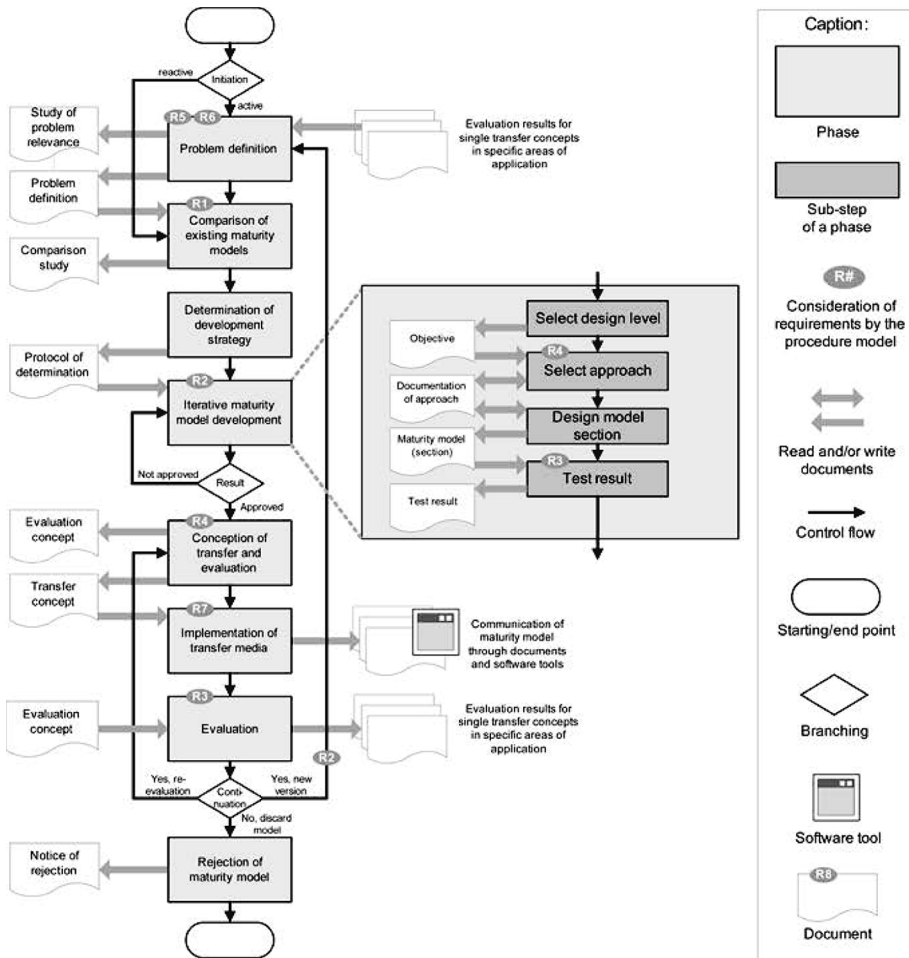

Figure 3: Procedure model for developing maturity models [Becker, J., Knackstedt, R. & Pöppelbuß, J. 2009. Developing maturity models for IT management. Business & Information Systems Engineering, 1, pp. 213-222, p. 218]

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22   Becker, J., Knackstedt, R. & Pöppelbuß, J. 2009. Developing maturity models for IT management. Business & Information Systems Engineering, 1, pp. 213-222, p. 213.

The procedure model should be applied by the researcher to design new maturity models and so overcome methodological shortcomings. The model has defined seven requirements that are spread over the phases. One of the core design procedures is the iterative approach shown as the procedure "Iterative maturity model development" that contains four further sub-procedures. The defined requirements R1 to R7 (in Table 1) of the procedural model are embedded in the different phases of the procedure model shown in Figure 3:

R1	Comparison with existing maturity models
R2	Iterative Procedure
R3	Evaluation
R4	Multi-methodological Procedure
R5	Identification of Problem Relevance
R6	Problem Definition
R7	Targeted publication of results

Table 1: Requirements of the procedure model [Becker, J., Knackstedt, R. & Pöppelbuß, J. 2009. Developing maturity models for IT management. Business & Information Systems Engineering, 1, pp. 213-222, p. 213]

The application of the procedure model on a tax-relevant process was practically applied by *Cuylen et al.*[23] The authors have developed a maturity model for the e-invoicing process (EIPMM) following the phases of *Becker et al.* by improving the existing best practice maturity models for e-invoices. Tax functions are dependent on the effective process execution of upstream processes. E-invoicing is a digitalization opportunity in the finance and tax area that reduces administrative costs, is improving productivity, and brings more process transparency.

The EIPMM by *Cuylen et al.* has been concluded after four iterations of Phase four "Iterative maturity model design" with changes after each iteration. The number of model components has been changing throughout the iterations. In the first iteration (literature review) five categories have been considered. Iterations two and three ended up with three categories but implementing sub-categories. Finally, after the fourth iteration, the model consists of four categories and fifteen subcategories.

The categories developed in the EIPMM are Strategy, Acceptance, Processes and Organization, and Technology. The category "Acceptance" matches with the category "Culture" in BPMMMs.

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23   Cuylen, A., Kosch, L. & Breitner, M. H. 2016. Development of a maturity model for electronic invoice processes. *Electronic Markets*, 26, pp. 115-127, pp. 121-125.